NFESC

# PRELIMINARY RESULTS
# Welding Emissions Study

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**OH&PM Workshop**

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# ESTCP COMPLIANCE PROJECT WELDING PULSED POWER SOURCE

## Project goal

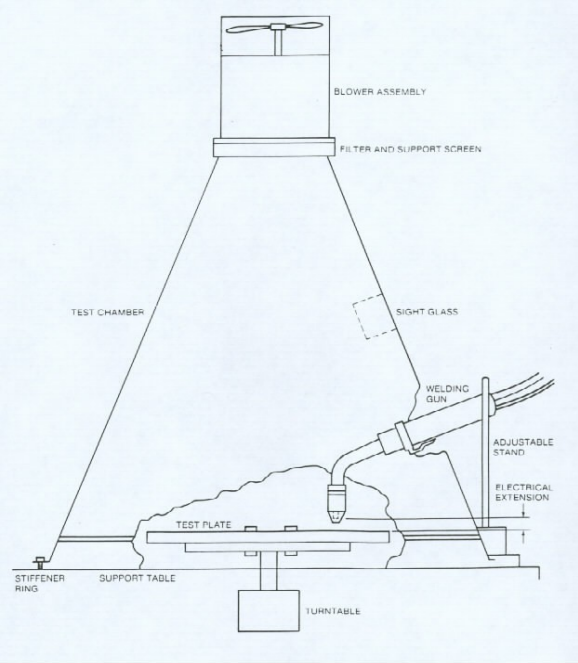
### Compare conventional power source to pulsed power source

1. **Laboratory Optimization**
   - **NSWCDC**
2. **Field Investigations – 4 DOD Sites**
   - **Environmental**
     - Real Time NOX, CO, $CO_2$,
     - Cascade impactor/metals
   - **Engineering (IH area) samples**
3. **Material Quality Testing**
4. **Data Analysis**
   - **What the heck happened ?**

# CHROMIUM = JUSTIFICATION

- **Chromium Standard *really* is coming**
  - **has been since ~ 1997**
- **Court ordered proposed rule release due October 2004**
  - **Best guess PEL ~ 1 ug/m$^3$**
- **Expect final regulation January 2006**
- **Plating, abrasive blasting, cutting, welding are primary DOD operations affected.**
- **EPA may be adding environmental regulations too.**

# OPTIMIZATION USING AWS F1.3 APPARATUS



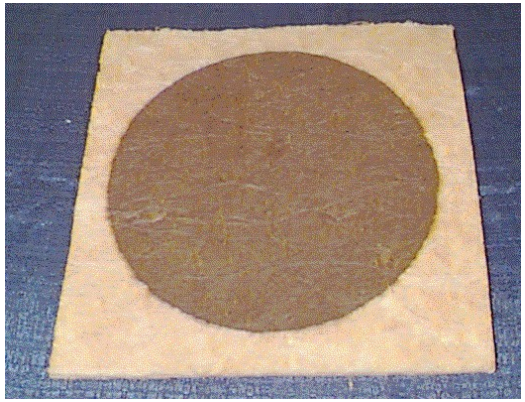

Fume Generation Rate Schematic

Fume Generation Rate Equipment

# FUME COLLECTION ON FILTERS

## Various welding wires and shielding gases

**LTEC 95**
**M-2 gas**
**30V/300A**



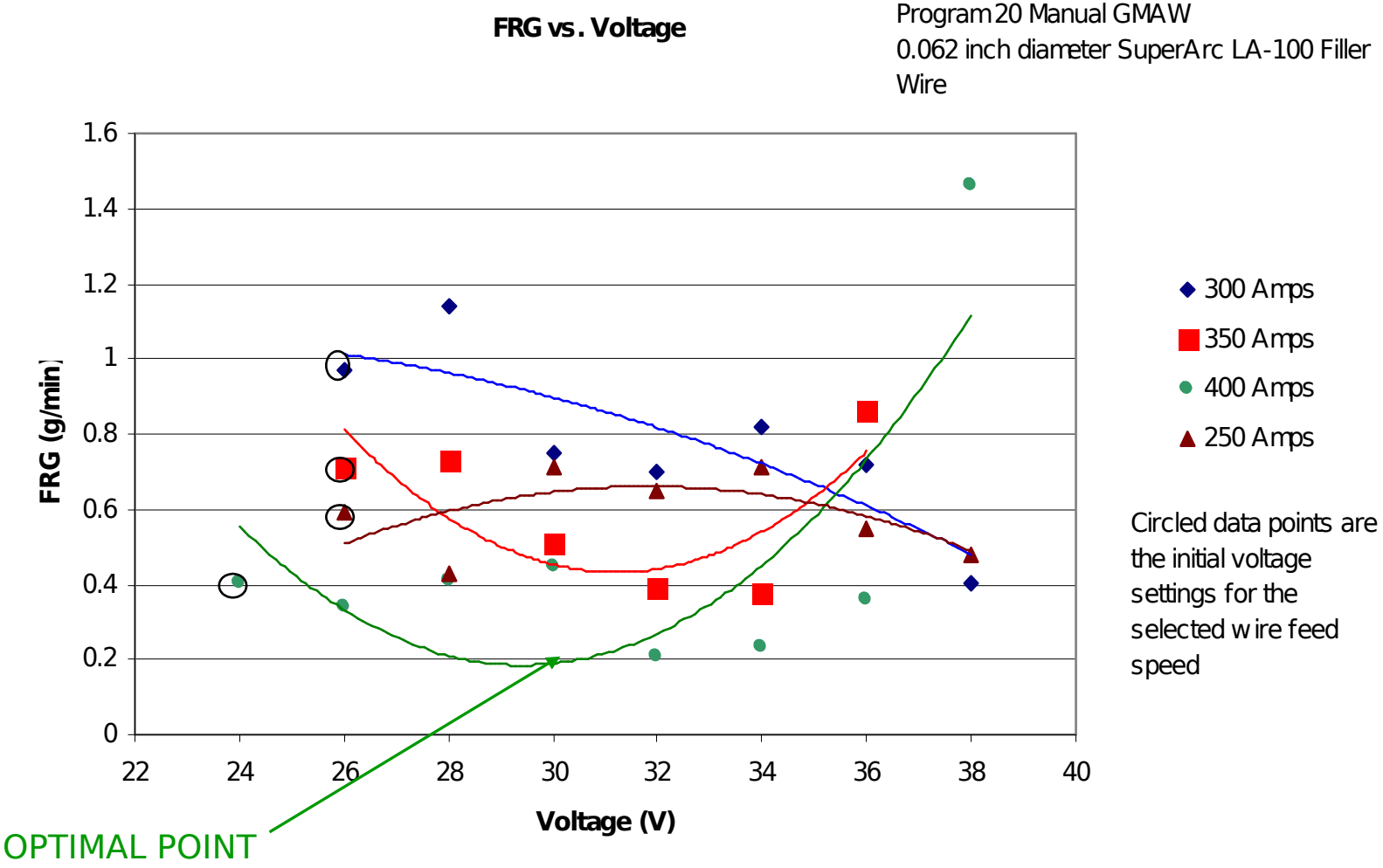
**1.3954**
**C-5 gas**
**30V/195 A**

**IN-625 FC**
**C-5 gas**
**26V/210A**

**IN-625 FC**
**$CO_2$ gas**
**37V/240A**

# EXAMPLE FUME GENERATION RATE DATA

Miller Invision 456 MP, S-74DX
Program 20 Manual GMAW
0.062 inch diameter SuperArc LA-100 Filler Wire




Circled data points are the initial voltage settings for the selected wire feed speed

# OPTIMAL FUME EMISSION POINT

- **Optimized fume emission point didn’t give the best quality weld**
- **Finally settled on welding manufacturer’s (Miller) test point for test sites 1 & 2**
- **Use manufacturer's (Lincoln & ESAB) recommendations for the test sites 3 & 4**

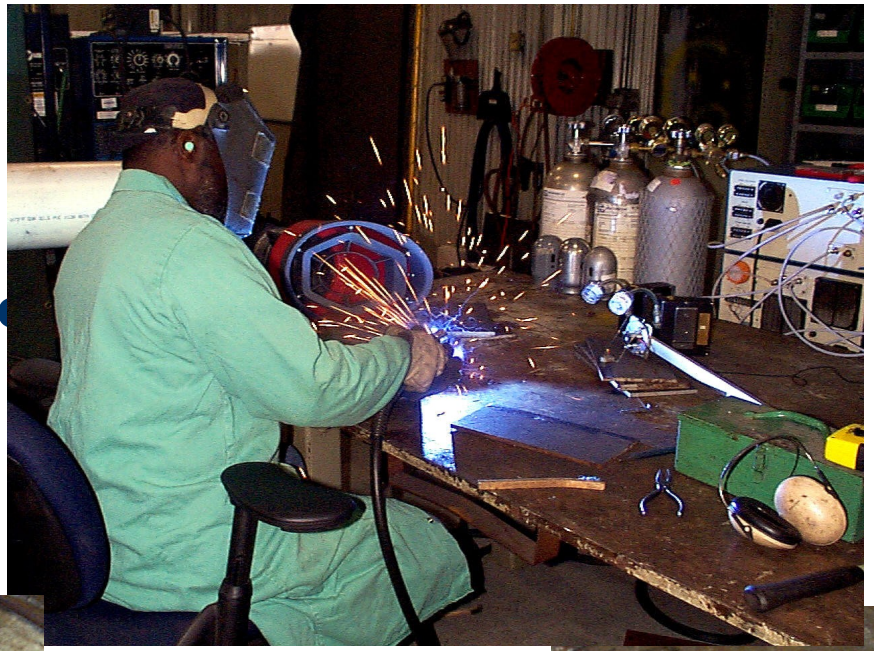
# FIELD TEST SITES

- **Army Depot, Anniston, AL/ armored vehicles**
  - **mild steel**
  - **aluminum (small sample)**
- **MCLB Albany, GA/ armored vehi**
  - **High alloy/high strength steel**
- **SIMA San Diego, CA/ ship repair**
  - **HY-80**
  - **Chrome-Moly boiler pipe**
- **PSNSY Bremerton, WA/ Ship overhaul**
  - **Carbon Steel**
  - **HY-80**

Marshall Coaxum running a test weld

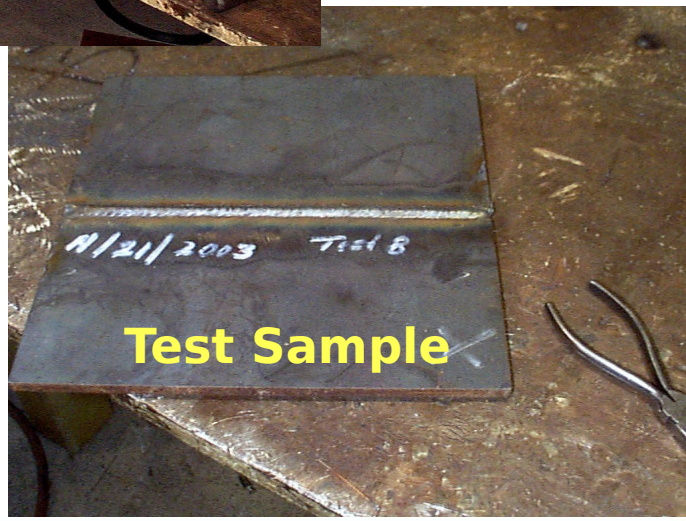
# WELD PROCESS REPORTING FACTORS

- Base Metal
- Filler Material
- Joining Process
- Gas Concentrati
- Welder
- Wire Speed
- Travel Speed

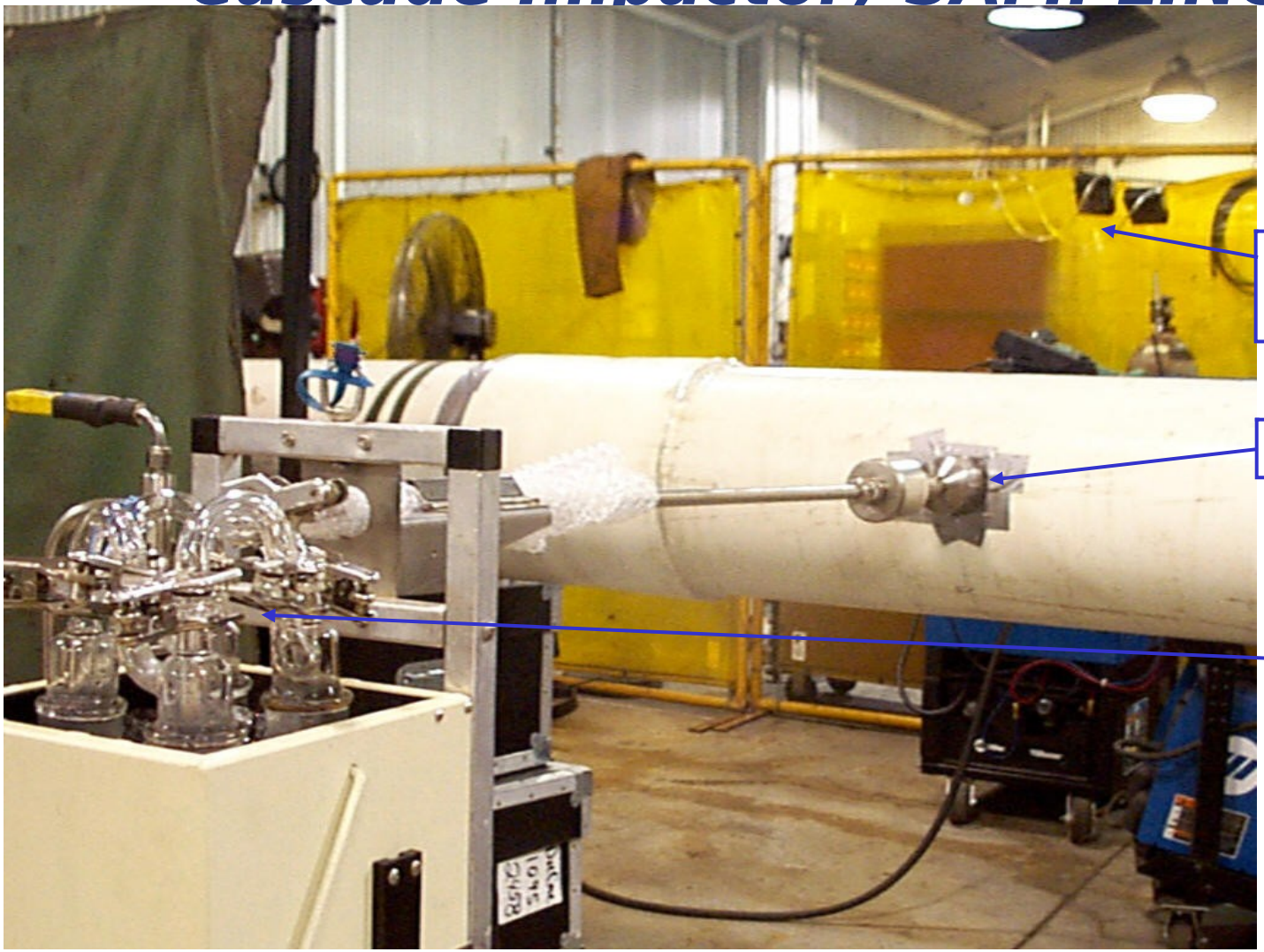


Marshall Coaxum did all our welding for two one week periods.

- Voltage
- Amperage
- Power Factor
- Arc time



# ENGINEERING (IH Area) & ENVIRONMENTAL (Anderson Cascade Impactor) SAMPLING



# OSH&E FIELD TESTING

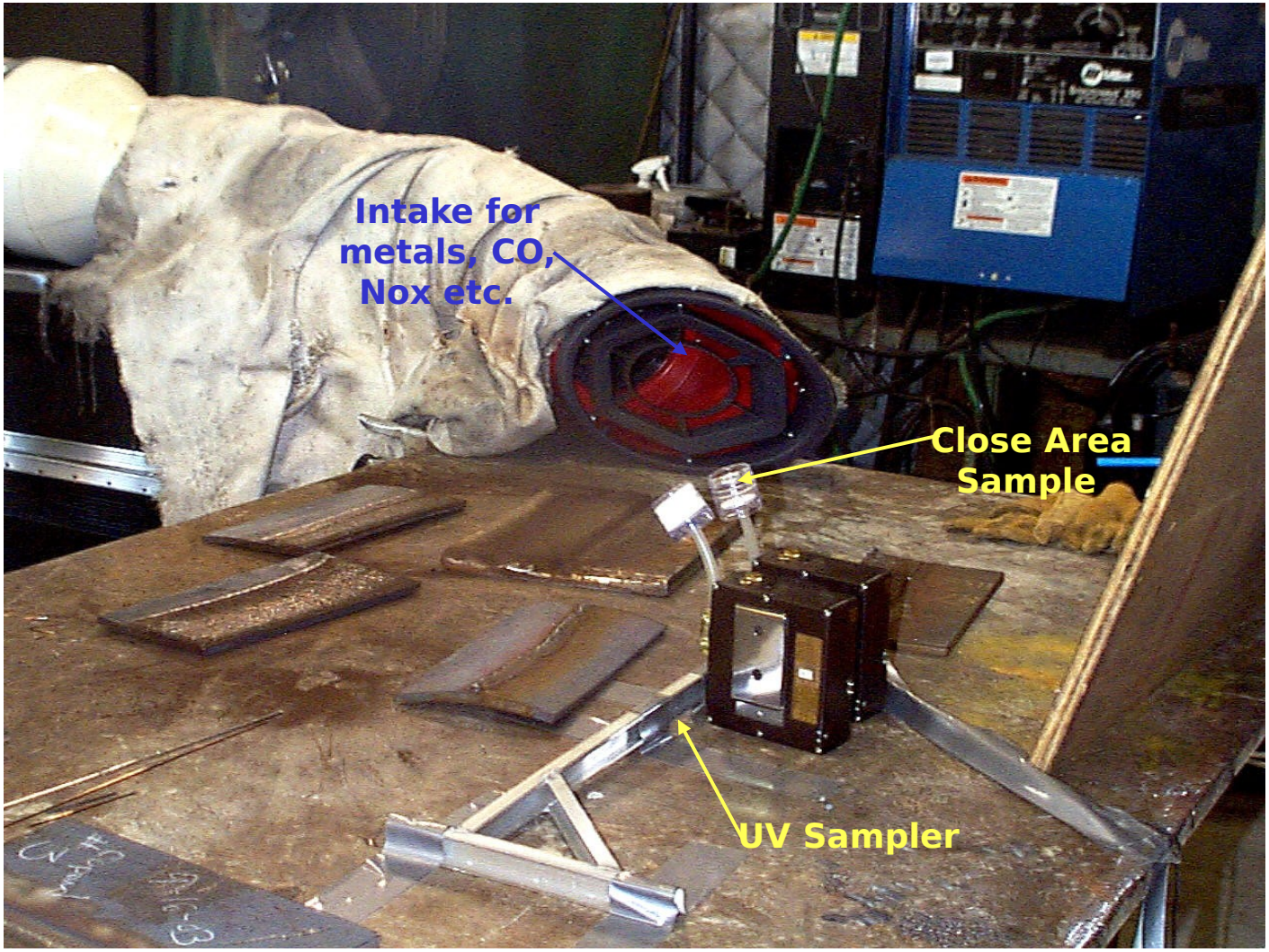
- **Environmental SET Parameters (8-stage Cascade Impactor in duct)**
  - **Metals - $Cr^{+6}$, Cr, Ni, Mg, Cu, Al, etc.**
  - **Goal ~ 40 minutes of welding arc time / OSH&E sample period (2-3/day)**

- **Environmental Real-time Parameters (in duct)**
  - **Ozone**
  - **NOx**
  - **CO**
  - **$CO_2$**

- **Engineering (IH Area) Samples**
  - **$Cr^{+6}$, Cr, Ni, Mg, Cu, Al, etc. @ one to two feet from weld (close range)**
  - **$Cr^{+6}$, Cr, Ni, Mg, Cu, Al, etc. @ ten feet from weld (ambient)**
  - **Sample time = 8 hours**

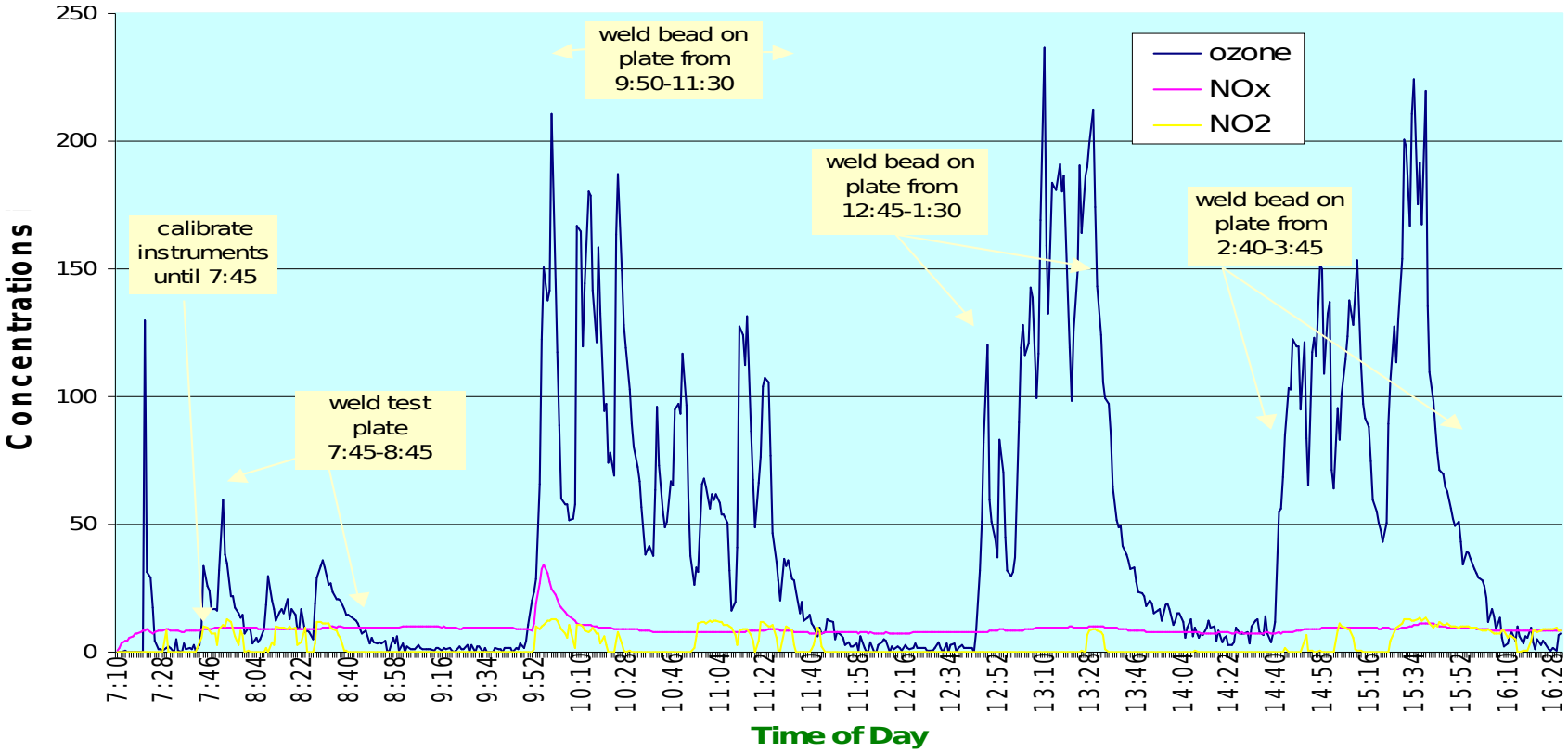
- **Other Tests**
  - **Ionizing Radiation – real-time**
  - **Heat Stress – Dropped from study (personally invasive test method)**

# ENGINEERING & ENVIRONMENTAL SAMPLING



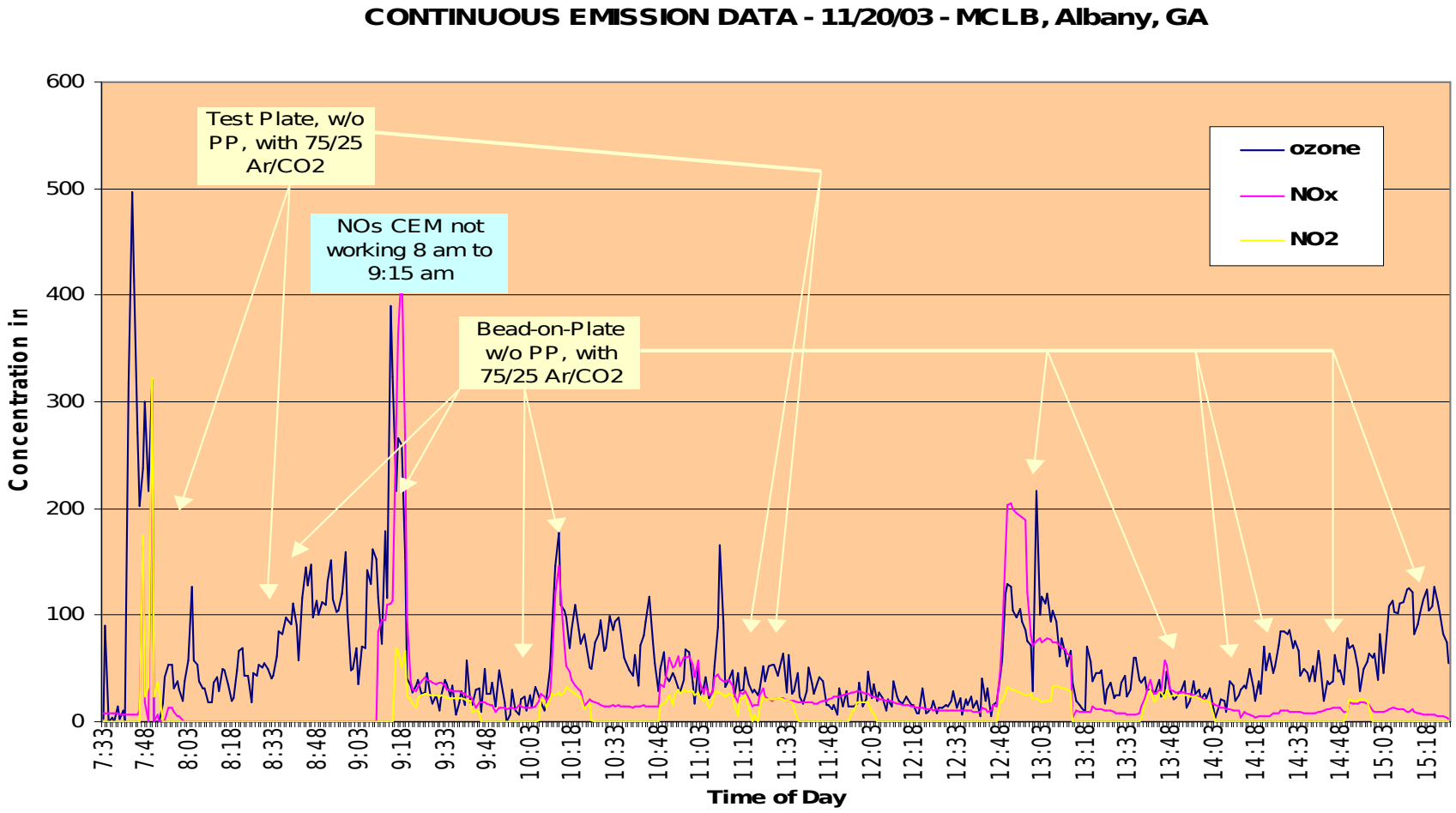
# SAMPLE REAL-TIME EMISSION DATA

## CONTINUOUS EMISSION DATA, ANAD - 10/29/03



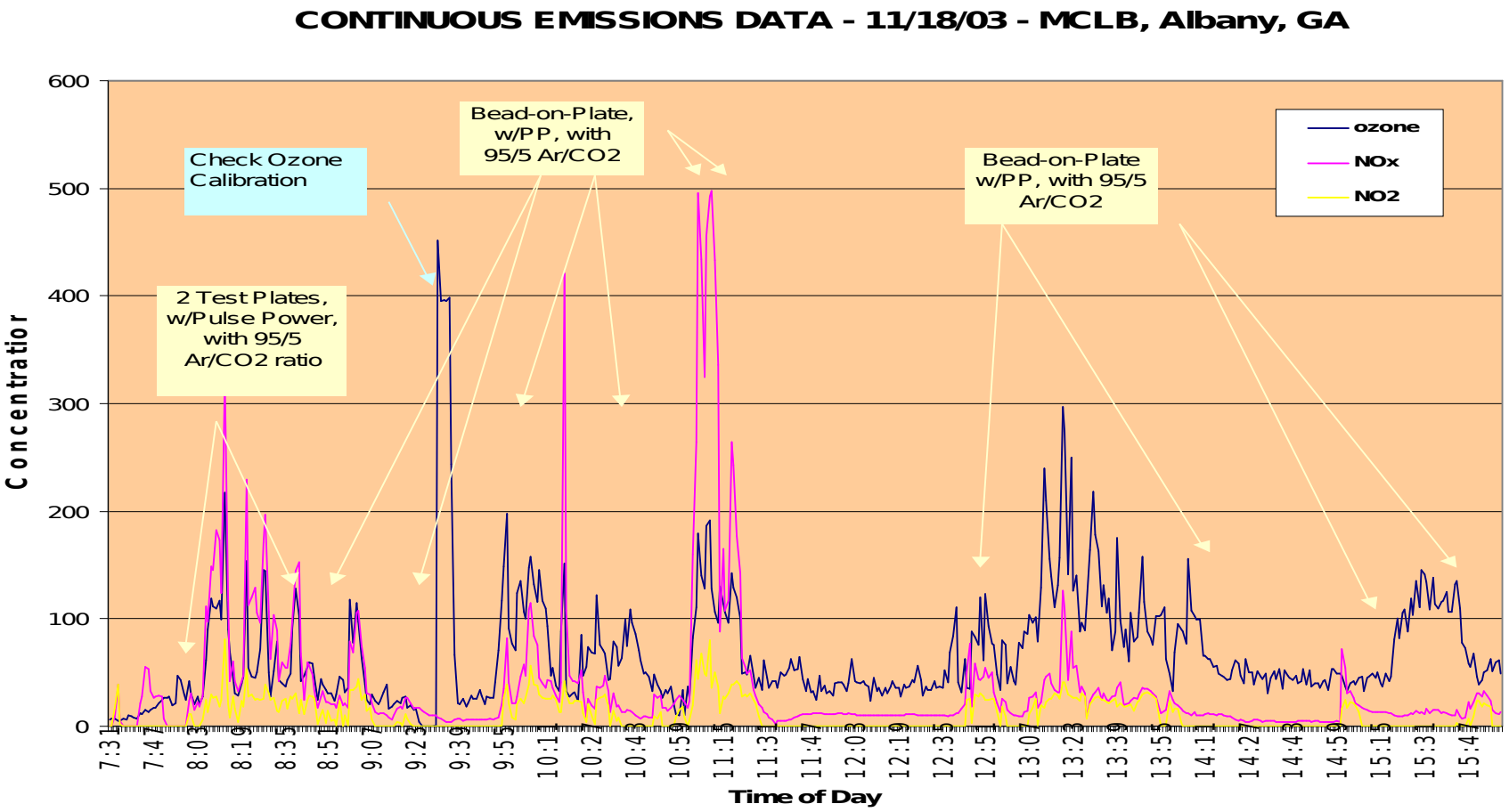

- Sample of ANAD Real-time Data from Nox and Ozone WITH Pulsed power
- CO not shown here but is generally unremarkable.

# SAMPLE REAL-TIME EMISSION DATA




- **Sample of MCLB Real-time Data from Nox and Ozone without pulsed power**
- **CO not shown here but is generally unremarkable.**

# SAMPLE REAL-TIME EMISSION DATA




- Sample of MCLB Real-time Data from Nox and Ozone WITH Pulsed power
- CO not shown here but is generally unremarkable.

# LESSONS LEARNED

- It is not difficult to understand why welding is so difficult to regulate.

- Fume generation parameters include
  - welder (skill, arc length)
  - weld position (flat, horizontal, vertical)
  - acceptance test method (AWS standard, local )
  - weld joint (butt, different joints)
  - base metal (aluminum, mild steel, stainless, armored)
  - filler metal (depends on the specification)
  - weld method (GMAW, TIG, stick, flux core)

"Doc" Holliday is about 6'5"

# LESSONS LEARNED - UV LIGHT

- **Not getting usable readings**
  - **Instantaneous arc at start is too quick for averaging meter**
  - **Total arc is also almost too quick @ about 1 minute average time.**
  - **One pass is ~ 1 minute**

- **Open for suggestions on real time data logger & instrumentation**
  - **Kathleen.Paulson@navy.mil e-mail**
  - **805-982-4984 / voice**

# PROJECT TEAM

***Naval Facilities Engineering Service Center, Port Hueneme, CA***

- ***Kathleen Paulson – PI***
- ***Jill Hamilton - Logistics***

- ***Naval Surface Warfare Center, Carderock Div, W Bethesda, MD***
  - ***Gene Franke – Optimization***
  - ***Joe Kalp – Materials QC***

## Project Support

- ***Navy Environmental & Preventive Medicine Unit 5, San Diego, CA,***
  - ***Dr Charles Kubrock & crew***
  - ***Laboratory Analysis for OSH&E samples***
- ***VERSAR, INC.***
  - ***Mr Stephan Schwartz & Tim Jensen***
  - ***OSH&E Sampling***
  - ***Report Prep***
- ***Bob Weber, Civil Engineering Research Lab, Champaign , IL***
  - ***Welding Procedure & QA/QC***
- ***Dr. Bhaskar Kura, PhD, University of New Orleans***
  - ***Welding procedure & environmental***